U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

5.4.2.1 STEAM GENERATOR MATERIALS

REVIEW RESPONSIBILITIES

Primary - ~~Materials Engineering Branch (MTEB)~~Materials and Chemical Engineering Branch (EMCB)[1]

Secondary - ~~Chemical Engineering Branch (CMEB)~~None[2]

I. AREAS OF REVIEW

General Design Criteria 1, 14, 15, and 31 of Appendix A of 10 CFR Part 50 require that components of the reactor coolant boundary be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure and of gross rupture. These criteria also require~~Also,~~[3] that such design will have sufficient margin to assure that design conditions are not exceeded during normal operation and anticipated operational occurrences.

A review is made of the following areas reported in the applicant's safety analysis report (SAR). These are all related to the ASME Boiler and Pressure Vessel Code (Reference 11)[4] (hereinafter "the Code") Class 1 and Class 2 components of pressurized water reactor (PWR) steam generators, including all components that constitute part of the reactor coolant pressure boundary.

A. ~~MTEB~~EMCB[5] reviews the following areas related to materials selection and design[6] as part of its primary review responsibility:

1. Selection and Fabrication of Materials

The materials selected for the steam generator are reviewed.

Components of the steam generator are divided into two classes: Class 1, which includes material for those parts exposed to the primary reactor coolant, and Class 2, which includes materials for parts exposed to the secondary coolant water.

The selection and fabrication of materials for all Class 1 and Class 2 components of pressurized water reactor (PWR) steam generators is reviewed for adequacy and suitability and for compliance with the requirements of the Code.

Examples of materials that are currently being used for Class 1 components include the following:

Tubing	-	ASME SB-163, Ni-Cr-Fe, annealed (Inconel 600)
	-	ASME SB-163, Ni-Cr-Fe (Inconel 690)[7]
Tube Sheet	-	ASME SA-502, C1 2 and 2a, weld-clad with Inconel 600 on the primary coolant side
Channel Head Casting or Channel Head Plate	-	ASME SA-533, Grade A, B, or C
Forged Nozzles	-	ASME SA-508, Class 2, and 2a

Examples of materials that are currently being used for Class 2 components include the following:

Shell Pressure Plates	-	ASME SA-533, Grade A, B, or C, Class 1 and 2
Bolting	-	ASME SA-193, Grade B-7 ASME SA-540, Grade B 23 or B 24
Tube Support Plates or Grids	-	ASME SA-240 ASME SA-479

The fracture toughness properties and requirements for ferritic materials of Class 1 and Class 2 components are reviewed.

2. Steam Generator Design

The design and the fabrication procedures are reviewed to determine that the extent of crevice areas are minimized in the completed steam generators. A "tube denting" phenomenon has occurred in a number of steam generators. Based on operating experience and laboratory testing, it is believed that the denting is associated with the growth of a corrosion product (principally Fe_3O_4) in the crevice. The corrosion is caused by the concentration of steam generator water impurities in the annulus. The growth of corrosion product puts inward pressure

on the tube resulting in radial deformation of the tube. As corrosion proceeds and in-plate forces accumulate, there are a number of secondary effects in the steam generator. These include (a) tube support plate hole dilation; (b) tube support plate flow hole distortion~~,~~ and[8] flow slot hour-glassing; (c) tube support plate expansion with cracking between hole ligaments; (d) wrapper distortion; (e) leg displacement of the smallest radius U-bend heat tube, and (f) tube leakage.

The extent of the tube to tube sheet contact and the contact area of the tube/tube support are of particular interest. The reviewer will evaluate the design and material selection used to minimize the support plate corrosion.

The tubes are commonly welded to the tube-sheet cladding and expanded into the tube sheet by rolling or explosive-expanding (explanding). Full depth expansion is the preferred design.

~~A secondary review is performed by CMEB and the results are used by MTEB to complete the overall evaluation for the steam generator materials.~~[9]

B.[10] EMCB~~CMEB~~[11] will review the following areas related to secondary water chemistry. T~~t~~he[12] results of its evaluation are ~~transmitted to MTEB for~~ incorporati~~on~~ed[13] into the SER:

1. Compatibility of the Steam Generator Components with the Primary and Secondary Coolant

   The possibility of stress-corrosion cracking, denting, pitting, and wastage of the tubes, as determined by the chemistry of both the primary and secondary coolants, is~~are~~ reviewed.[14] The methods to be used in monitoring and maintaining the chemistry of the secondary coolant within the specified ranges are reviewed. The compatibility of austenitic and ferritic stainless steels, ferritic low alloy steels and carbon steels with the primary and secondary coolants is reviewed.

2. Cleanup of Secondary Side

   The provisions for access to, as well as the procedures and methods for, the removal of surface deposits, sludge, and corrosion products from the secondary side of the steam generator are reviewed. These provisions are to supplement the removal of sludge by blowdown.

Review Interfaces:

EMCB also performs the following reviews under the SRP sections indicated:

1. Reviews the adequacy of programs for assuring the integrity of bolting and threaded fasteners as part of its primary review responsibility for SRP Section 3.13 (proposed).

2. Reviews the suitability and adequacy of reactor coolant pressure boundary materials and verifies they meet applicable portions of the ASME Code as part of its primary review responsibility for SRP Section 5.2.3.

3. Reviews the suitability and adequacy of steam and feedwater system materials as part of its primary review responsibility for SRP Section 10.3.6.

4. Reviews the capability of the condensate cleanup system to provide feedwater to the steam generators that meets water purity requirements as part of its primary review responsibility for SRP Section 10.4.6.

5. Reviews the capability of the steam generator blowdown system to assist in maintaining the optimum secondary-side water chemistry in the steam generators as part of its primary review responsibility for SRP Section 10.4.8.

In addition, the EMCB will coordinate other branches' evaluations that interface with the overall review of the system as follows:

1. The Mechanical Engineering Branch (EMEB) reviews the structural integrity of pressure retaining components designed in accordance with the ASME code as part of its primary review responsibility for SRP Section 3.9.3.

2. The Mechanical Engineering Branch (EMEB) reviews pressure retaining components for compliance with the Codes and Standards Rule (10 CFR 50.55a) and/or for the use of acceptable code cases as part of its primary review responsibility for SRP Sections 5.2.1.1 and 5.2.1.2.

For those areas of review identified above as being part of the review under other SRP sections, the acceptance criteria and their methods of application are contained in the referenced SRP sections.[15] [16]

II. ACCEPTANCE CRITERIA

The acceptance criteria for the areas of review described in subsection I of this SRP section are based on meeting the following relevant requirements of General Design Criteria 1, 14, 15, and 31, and Appendix B to 10 CFR Part 50:

1. GDC 1 - Quality Standards and Records

Structures, systems, and components (SSC)[17] important to safety shall be designed, fabricated, erected, and tested to quality standards~~,~~[18] commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency, and shall be supplemented in order to provide adequate assurance that these ~~structures, systems, and components,~~SSC[19] will perform their safety functions and that records will~~shall~~[20] be maintained.

2. GDC 14 - Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

3. GDC 15 - Reactor Coolant System Design

The reactor coolant system~~,~~ and associated auxiliary control~~,~~[21] and protection systems shall be designed with sufficient margin to assure that design conditions of the reactor coolant boundary are not exceeded during any condition of normal operation, including anticipated operational occurrences.

4. GDC 31 - Fracture Prevention of Reactor Coolant Pressure Boundary

The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions, a.~~(1)~~ the boundary behaves in a nonbrittle manner, and b.~~(2)~~[22] the probability of rapidly propagating fracture is minimized.

5. Appendix B, 10 CFR Part 50 - "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants~~:~~," Criterion XIII, "Handling, Storage and Shipping"[23]

This regulation states that measures shall[24] be established to control the cleaning of material and equipment in accordance with work and inspection procedures to prevent damage or deterioration.

Specific criteria necessary to meet the relevant requirements of the Commission regulations identified above are:

A. ~~Primary~~ Materials[25] Review Criteria

1. Selection and Fabrication of Materials

a. To meet the requirements of GDC 1, the acceptable materials for steam generator components are those identified and permitted in the ASME Code, Appendix I of Section III, and specified in detail in the Code Parts A, B, and C of Section II. Any materials specified in the design to meet code-case requirements ~~must also meet the requirements given~~should conform with the guidance for acceptable code-cases and use thereof described[26] in Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III Division I ~~Materials~~."[27] Any materials selected for the tube support structure should be justified on the basis of minimizing the denting and corrosion of the tubes.

b. To meet the requirements of GDC 1, 14, and 31, the fracture toughness of ferritic materials used for Class 1 components in the steam generator must

meet the requirements of Appendix G of 10 CFR Part 50, as augmented by Subarticle NB-2300, Section III of the Code and Appendix G, Article G-2000 of the Code.

The fracture toughness properties of the ferritic materials selected for Class 2 components in the steam generator must meet the requirements of Subarticle NC-2300 of the Code.

c. To meet the requirements of GDC 1, the welding qualification, weld fabrication processes and inspection during fabrication and assembly of the steam generator must be conducted in conformance with the requirements of Section III and IX of the Code.

d. To meet the requirements of GDC 1, the corrosion-resistant weld-deposited cladding on the tube sheet and on other primary side components must be fabricated and inspected according to the requirements given in Articles I, II, III, and IV, Part QW of Section IX of the Code.

e. To meet the requirements of GDC 1, the welds between the tubes and the tube sheet must meet the requirements of Section III and Section IX of the Code.

f. To meet the requirements of GDC 14, the processing and heat treatment of the steam generator tubing will be evaluated on a case basis. Special heat treatment to improve the corrosion resistance of the tubing should have supporting data.

2. Steam Generator Design

a.[28] To meet the requirements of GDC 14, 15, and 31, the steam generators must be designed to avoid extensive crevice areas where the tubes pass through the tube sheet, and where the tubes pass through tubing supports, as indicated in Branch Technical Position EMCB~~MTEB~~[29] 5-3, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generators."

At the tube/tube sheet interface, the tubes should be rolled or expanded for the full depth of the tube sheet to avoid the presence of a crevice. The tube support structure should be designed to promote high velocity flow along the tubes. This will minimize the buildup of corrosion product and sludge in the crevices of the tube/tube support structure.

b. To meet the requirements of GDC 15, the corrosion allowance for the steam generator materials should meet Section III of the ASME Code and account for the design life of the plant.[30]

B. ~~Secondary~~Chemistry[31] Review Criteria

1. Compatibility of the Steam Generator Tubing with the Primary and Secondary Coolant

The requirements of GDC 14, 15, and 31 are met if the acceptance criteria for primary coolant chemistry given in Standard Review Plan Section 5.2.3, "RCPB Materials," are used and if the secondary coolant chemistry is maintained and ~~purity are~~[32] monitored as described in Branch Technical Position EMCB~~MTEB~~[33] 5-3.

2. Cleanup of Secondary Side

a.[34] To meet the requirements of GDC 14 and 15, the steam generators must be designed to provide adequate access to the internals so that tools may be inserted to inspect and clean up deposits~~,~~[35] on the tube sheet and on the tube/tube support. Procedures, such as lancing to remove deposits, should be described.

~~3.~~ b. To meet the requirements of GDC 1 and Appendix B to 10 CFR Part 50, onsite cleaning and cleanliness control should be in accordance with the position given in Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," and in ANSI N45.2.1-1973, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants~~,~~" (Reference 12).[36]

Technical Rationale:[37]

The technical rationale for application of the above acceptance criteria to the design of steam generator materials are discussed in the following paragraphs:

1. GDC 1 requires that structures, systems, and components be designed, fabricated, erected, constructed, tested and inspected to the highest quality standards commensurate with the importance of the safety function to be performed. The steam generator may be relied upon to perform safety functions such as removing decay heat or supplying steam to engineered safety feature pumps. It also forms a portion of the reactor coolant pressure boundary. This SRP Section evaluates the design, selection, fabrication, cleaning and chemistry controls of the steam generator materials. Regulatory Guide 1.85 describes acceptable ASME code cases that may be used in materials selection and fabrication. Meeting the requirements of GDC 1 and the positions of Regulatory Guide 1.85 assures system integrity and the ability to support emergency core cooling.

2. GDC 14 requires that all RCPB components be designed and constructed such that there is an extremely low probability that these components will fail and cause a primary leak or loss of coolant accident. The steam generator is an integral part of the reactor coolant pressure boundary that performs the vital function of separating the radioactive primary

system from the clean secondary system. Primary leakage into the secondary system could lead to the direct release of radioactivity outside of the containment. Meeting GDC 14 design and construction standards will ensure that the potential for a primary to secondary leak and contamination of the secondary is minimized thus reducing the potential for release of radioactivity outside of the containment.

3. GDC 15 requires that the reactor coolant pressure boundary be designed, constructed, and tested with sufficient margin to assure that design conditions are not exceeded during normal operation or anticipated operational occurrences. The steam generator is a part of the reactor coolant pressure boundary and provides for emergency core cooling under certain transients. Requiring margin between operational and design conditions ensures that the integrity of the reactor coolant pressure boundary is maintained and that the steam generator can fulfill its emergency core cooling safety functions during the most severe transients expected.

4. GDC 31 requires that the reactor coolant pressure boundary be designed with sufficient margin to preclude brittle fracture during expected operational, maintenance, testing, and accident conditions. The steam generator is a part of the reactor coolant pressure boundary and provides one of the means of emergency core cooling. Requiring design margins to brittle fracture limits ensures that the integrity of the reactor coolant pressure boundary is maintained and that the steam generator can fulfill its emergency core cooling safety functions during the most severe transients expected.

5. 10 CFR 50 Appendix B provides quality assurance requirements for the design, construction, and operation of safety related structures, systems and components of a nuclear plant. Criterion XIII specifically requires controls for the cleaning and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration. The steam generator is a part of the reactor coolant pressure boundary and provides one of the means of emergency core cooling. Regulatory Guide 1.37 describes acceptable standards for cleaning and cleanliness control to prevent material damage or deterioration. By meeting criterion XIII of 10 CFR 50 Appendix B and the positions of Regulatory Guide 1.37, assurance is provided that the steam generator materials are protected from damage due to corrosion or contamination, thus providing a high degree of certainty that assigned steam generator safety functions will be performed and the health and safety of the public will be protected.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

For each area of review, the following review procedure is used by the reviewer[38]:

A. Materials Review~~Primary Reviewer~~[39]

1. Selection and Fabrication of Materials

The reviewer examines the materials and fabrication procedures as given in the SAR for Class 1 and Class 2 components of the steam generators, to determine the degree of conformance with the acceptance criteria stated in subsection II.A.1[40] of this SRP section, and verifies that information relative to toughness tests is in conformance with the acceptance criteria stated in subsection II.A.1.b, above. The reviewer verifies that the tubes are properly welded and expanded into the tube sheet, and that proper care is taken to maintain cleanliness during fabrication, assembly, and installation of the unit.

If stainless steel materials are used in the design of the steam generator, the reviewer should verify that the applicant has adequately addressed the potential for intergranular stress corrosion cracking (IGSCC). The reviewer should use the applicable criteria of SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials," as they relate to material selection and fabrication process controls for stainless steel.[41]

Operating experience has indicated that certain nickel-chromium-iron alloys (e.g. Inconel) are susceptible to cracking due to corrosion. Thermally treated Inconel 690 alloy has improved corrosion resistance in comparison to Inconel 600 alloy previously used in steam generator applications. Where nickel-chromium-iron alloys are proposed for use in the steam generator, the reviewer verifies that an acceptable technical basis is either identified (based upon demonstrated satisfactory use in similar applications) or presented by the applicant to support use of the material under the expected environmental conditions.[42]

The reviewer verifies that appropriate bolting material has been selected which will perform adequately under the expected service conditions and which is not subject to stress corrosion cracking. Regulatory Guide 1.65 provides guidance for the design of reactor vessel closure studs which is also appropriate for the selection of suitable steam generator bolting material.[43]

2. Steam Generator Design

The reviewer examines the design of the steam generators to verify that tight crevice areas where tubes pass through the tube supports and tube plate(s) are minimized, as discussed in subsection II.A.2[44] of this SRP section.

The reviewer verifies that an adequate corrosion allowance that meets Section III of the ASME Code and accounts for the design life of the plant has been specified.[45]

B. Chemistry Review~~Secondary Reviewer~~[46]

1. Compatibility of the Steam Generator Tubing with the Primary and Secondary Coolant

The reviewer examines the controls to be placed on the composition of the primary and secondary coolants to determine that they meet the acceptance criteria cited in subsection II.B.1 of this SRP section.

2. Cleanup of Secondary Side

The reviewer examines the design provisions that allow implementation of the procedures and methods to be used for removal of surface deposits, sludge, and corrosion products from the tube sheet and the tube/tube support areas.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[47]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information is provided in accordance with the requirements of this SRP section and that ~~his~~the[48] evaluation supports conclusions of the following type, which are to be included, as applicable,[49] in the staff's safety evaluation report:

The staff concludes that the steam generator materials specified are acceptable and meet the requirements of GDC 1, 14, 15, and 31, and Appendix B to 10 CFR Part 50. This conclusion is based on the following:

1. The applicant has met the requirements of GDC 1 with respect to codes and standards by assuring that the materials selected for use in Class 1 and Class 2 components will be fabricated and inspected in conformance with codes, standards, and specifications acceptable to the staff. Welding qualification, fabrication, and inspection during manufacture and assembly of the steam generator will be done in conformance with the requirements of Sections III and IX of the ASME Code.

2. The requirements of GDC 14 and 15 have been met to assure that the reactor coolant boundary and associated auxiliary systems have been designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapid failure and of gross rupture, during normal operation and anticipated operational occurrences. The primary side of the steam generator is designed and fabricated to comply with ASME Class 1 criteria as required by the staff. (The secondary side pressure boundary parts of the steam generator will

be designed, manufactured, and tested to ASME Class 1 criteria although the staff required classification is ASME Class 2.)*

The crevice between the tube sheet and the inserted tube will be minimal because the tube will be expanded to the full depth of insertion of the tube in the tube sheet. The tube expansion and subsequent positive contact pressure between the tube and the tube sheet will preclude a buildup of impurities from forming in the crevice region and reduce the probability of crevice boiling.

(The tube support plates will be manufactured from ferritic stainless steel material, which has been shown in laboratory tests to be corrosion resistant to the operating environment.)* (The tube support plates will be designed and manufactured with broached holes rather than drilled holes. The broached hole design promotes high velocity flow along the tube, sweeping impurities away from the support plates locations.)*[50] (The tube support structure will be manufactured to the egg crate design. The egg crate design eliminates the narrow annular gap at the tube supports, because the support may contact the tube at only four lines on the tube circumference, and provides almost complete washing of the tube surface with steam generator water.)*

If austenitic stainless steel is utilized, the review includes appropriate findings from SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials," for material selection and fabrication process controls for stainless steel.[51]

An adequate corrosion allowance which meets Section III of the ASME Code and accounts for the design life of the plant has been specified.[52]

3. The requirements of GDC 31 have been met with respect to the fracture toughness of the ferritic materials since the pressure boundary materials of ASME Class 1 components of the steam generator will comply with the fracture toughness requirements and tests of Subarticle NB-2300 of Section III of the Code. The materials of the ASME Class 2 components of the steam generator will comply with the fracture toughness requirements of Subarticle NC-2300 of Section III of the Code.

4. The requirements of Appendix B of 10 CFR Part 50 have been met since the onsite cleaning and cleanliness controls during fabrication (will)* conform to the recommendations of Regulatory Guide 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants." The controls placed on the secondary coolant chemistry are in agreement with staff technical positions.

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*Include material within parentheses as applicable.

Reasonable assurance of the satisfactory performance of steam generator tubing and other generator materials is provided by (a) the design provisions and the manufacturing requirements of the ASME Code, (b) rigorous secondary water monitoring and control, and (c) the limiting of condenser in-leakage. The controls described above combined with conformance with applicable codes, standards, staff positions, and regulatory guides constitute an acceptable basis for meeting in part the requirements of General Design Criteria 1, 14, 15, and 31, and Appendix B, 10 CFR Part 50.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[53]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[54] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[55]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criteria~~on~~[56] 1, "Quality Standards and Records.~~,~~"[57]

2.[58] 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary.~~,~~"

3. 10 CFR Part 50, Appendix A, General Design Criterion 15, "Reactor Coolant System Design.~~,~~" ~~and~~

4. 10 CFR Part 50, Appendix A, General Design Criterion 31, "Fracture Prevention of the Reactor Coolant Pressure Boundary."

58. ~~Appendix B,~~ 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."[59]

6. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements."[60]

74. Regulatory Guide 1.37, "Quality Assurance Requirements for~~of~~ Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants."[61]

8. Regulatory Guide 1.65, "Materials and Inspections for Reactor Vessel Closure Studs."[62]

95. Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III Division I ~~Material~~."[63]

~~6. Standard Review Plan Section 5.2.3, "RCPB Materials."[64]~~

107. Branch Technical Position EMCB~~MTEB~~[65] 5-3, "Monitoring of Secondary Side Water Chemistry in PWR Steam Generators," attached to this SRP section.

112. ASME Boiler and Pressure Vessel Code, Parts A, B, and C of Section II, Section III, and Section IX, American Society of Mechanical Engineers.

123. ANSI N45.2.1-1973, "Cleaning of Fluid Systems and Associated Components During Construction Phase of Nuclear Power Plants," American National Standards Institute.[66]

BRANCH TECHNICAL POSITION EMCB~~MTEB~~ 5-3
(Previously MTEB 5-3)[67]

MONITORING OF SECONDARY SIDE WATER
CHEMISTRY IN PWR STEAM GENERATORS

I. BACKGROUND

Effective long-term reliable operation of PWR steam generators requires that operational procedures, design, and selection of materials be such that there is no leakage across the steam generator tubes and that the barrier between the primary and secondary fluids maintains its integrity under operating, maintenance or testing conditions as stated in General Design Criteria 14, 15, and 31 of Appendix A of 10 CFR Part 50.

These objectives are generally met by providing water treatments to remove impurities from the secondary side water, operation procedures to remove accumulated sludges and insoluble impurities from generators, design of equipment to prevent impurities from entering the system with makeup water and design factors to prevent the impurities from concentrating and forming sludges or deposits, especially in crevices.

Less than thoroughly effective water treatment, operational procedures, and design factors have led to the degradation of steam generator tubing, as documented by an extensive history of stress corrosion cracking, wastage, and denting of steam generator tubing in operating PWRs~~, has developed~~.[68] Therefore we recommend the following criteria.

II. BRANCH TECHNICAL POSITION[69]

1. Crevices between the tubing and the tube sheets or tubing supports should be minimized to prevent concentration of impurities or solids in these areas. To achieve this goal the tubes at the tube/tube sheet interface should be expanded for the full depth of the tube sheet.

   To minimize the deposition of corrosion products and sludge between the tubes and the supporting structure, the tube/tube support interface should be designed to promote high velocity water flow at the interface. This would improve the "washing" of this area.

2. Regulatory Guide 1.37 endorses ANSI N45.2.1 and states in part, "The surface (of components) shall appear metal clear. Scattered areas of rust are permissible provided the aggregate area of rust does not exceed two square inches in any one square foot area."[70] Experimental work has shown that a porous packing of oxide in the tube support annulus is one of the conditions resulting in the concentration of contaminants which leads to runaway corrosion of the tube support plate. Nuclear plant operators should start up the steam generators with "metal clean" surfaces. A method of confirmation such as photographing the inside of the steam generator should be undertaken after hot functional testing to confirm the "metal clean" condition.

3. a. In the FSAR, the applicant should describe implementation of a secondary water chemistry and monitoring program (in accordance with reference nuclear steam system supplier's recommended procedure) to inhibit steam generator corrosion and tube degradation. Applicants should meet EPRI NP-6239, "PWR Secondary Water Chemistry Guidelines," (Reference 2) as supplemented by Table 1, or equivalent appropriate guidelines.[71] This program should cover the following operational modes: (1) power operation (normal), (2) startup, (3) hot standby, (4) hot shutdown, and (5) cold shutdown/cold wet layup.

Each of the above modes should be defined with regards to percent rated thermal power and approximate temperature range~~, Fahrenheit~~.[72]

b. The secondary water chemistry monitoring and control program should include ~~the following:(1)I~~identification[73] of a sampling schedule for critical parameters during each mode of operation and of acceptance control criteria for these parameters. The program should include as a minimum the control of pH, cation conductivity, free sodium, and dissolved oxygen. However, other parameters such as specific conductivity, chlorine, fluorine, suspended solids, silica, total iron, copper, ammonia, and residual hydrazine merit consideration. In plants having more than one steam generator, additives to each steam generator should be controlled separately.

c. The Nuclear Regulatory Commission will review the secondary water chemistry control and monitoring program of each individual plant. The applicant should meet EPRI NP-6239 as supplemented by Table 1, or equivalent appropriate guidelines, and incorporate the technical recommendations of the steam generator supplier. Any significant deviation from EPRI NP-6239, Table 1, or the supplier's recommendations should be noted and justified technically.[74]

Records should be made of the monitored item values~~, and in accordance with 10 CFR Part 50, §50.71(a) they shall~~ and should[75] be made available for audit and inspection when deemed necessary.

Each licensee as part of ~~his~~the[76] annual operating report should include an evaluation of the secondary side water chemistry program with an evaluation of the trends and a summary of the total time during the reporting period the various chemistry parameters were out-of-specification.

d. For plants utilizing volatile chemistry:

(1) The composition, quantities, and addition rates of additives should be recorded. Routine changes in these items should be reported under biannual FSAR update as required by 10 CFR ~~Part 50,~~ 50.71.[77] However, nonconservative changes, i.e., relaxation in sample frequency~~,~~ or changes in impurity limits,[78] shall be submitted to NRC for approval before the change is implemented.

(2) The electrical conductivity and the pH of the bulk steam generator water and feedwater should be measured continuously. Assurance should be provided that the sample taken at the blowdown is typical of the bulk steam generator water and that there is a minimum bypass between the feedwater inlet and the blowdown sampling point.

(3) For once-through steam generators, the pH and electrical conductivity at the coolant inlet should be measured continuously.

(4) Free hydroxide concentration and impurities (particularly chloride, ammonia and silica) in the steam generator water should be measured at least three times per week.

e. For plants utilizing phosphate treatment:

(1) The composition, quantity, and addition rate of each additive should be recorded initially and thereafter whenever a change is made.

(2) The $Na/P0_4$ molar ratio of the secondary coolant should be recorded initially and whenever a change is made. $Na/P0_4$ ratio must be rigidly controlled. ($Na/P0_4$ ratio is to be held $\geq 2.3 \leq 2.6$).

(3) The electrical conductivity and pH of the bulk steam generator water and feedwater should be measured continuously. Assurance should be provided that the sample taken at the blowdown is typical of the bulk steam generator water and that there is a minimum bypass between the feedwater inlet and the blowdown sampling point.

(4) The concentration of suspended/dissolved solids and impurities (particularly free caustic, chloride, and silica) in the steam generator water should be measured daily.

(5) The concentration of dissolved solids (particularly sodium and phosphate) in the blowdown liquid should be measured once each week.

(6) The rate of blowdown should be recorded initially and whenever a change in rate is made.

(7) The hideout and reverse hideout of phosphate should be recorded. The phosphate concentration in each steam generator (or in one steam generator if this is shown to be representative of all) and in the blowdown liquid should be measured before and after each planned power level change of 10% or greater, and should be measured after each unplanned power level change of 20% or greater.

f. For All PWR Plants

(1) Condenser cooling water in-leakage to the condensate has been identified as the major source of impurity ingress in the PWR secondary feedwater. The combination of impurity ingress with corrosion of copper containing alloys and corrosion product transport (Fe_3O_4, NiO_2, etc.) in the secondary water system produces sludge that is difficult to remove and is reactive to steam generator materials.

In reporting the program,[79] the following guidelines should be observed:

(a) Monitor the condensate water quality at the condensate pump discharge as a minimum. Supplement as necessary by samples from the condenser hot well and condenser discharge.

(b) Measure the cation conductivity and oxygen.

(c) Maintain condensate impurity level at 0.1 ppm ± 0.05 ppm, oxygen at ≤ 5 ppb.

(d) A cation conductivity increase of 5 to 10 µS/m (0.05 to 0.10 µmho/cm)[80] justifies on-line investigation of possible contamination.

(e) An increase of 10 to 20 µS/m (0.10 to 0.20 µmho/cm)[81] is considered an indication of condenser leakage.

(f) When a condenser leak is confirmed, the leak should be repaired or plugged within 96 hours, or before the total integrated conductivity increase reaches 2000 µS/m hrs (20 µmho/cm hrs).[82] The staff will consider other impurity-time limit proposals for limiting the quantity of impurities entering the steam generator.

(2) Identify the procedures used to measure the value of each of the critical parameters. Provide the procedure title, the applicant/licensee's procedure number, and the basis (i.e., ASTM No.).

(3) Identify sampling points. The program should consider sampling the steam generator blowdown, the hot well discharge, the feedwater, and demineralizer effluent as a minimum of sampling points.

(4) State the procedure for recording and management of data.

(5) State the procedures defining corrective action for various out-of-specification parameters. The procedures should define the allowable time for correction of out-of-specification chemistry.

(6) Identify (a) the authority responsible for the interpretation of the data, and (b) the sequence and timing of administrative events required to initiate corrective action.

(7) Identify major components of the secondary water system and materials in contact with secondary water coolant.

III. REFERENCES

1. 10 CFR Part 50.71, "Maintenance of Records, Making of Reports."[83]

2. EPRI NP-6239, "PWR Secondary Water Chemistry Guidelines," Revision 2, December 1988, Electric Power Research Institute.[84]

Table 1 Makeup Water Chemistry Guidelines[85]

Water Quality Parameter	MWST	MWSG
pH (minimum)	-	7.0
(maximum)	-	7.5
Conductivity at 25°C (µS/cm)	<0.2	<0.1
Sodium (ppb)	-	<3.0
Silica (ppb)	-	<10
Oxygen (ppm) maximum	0.100	-
Chloride (ppm) maximum	0.15	-
Fluoride (ppm) maximum	0.15	-
Suspended Solids (ppm) maximum*	1.0	-
Boric Acid (ppm)	-	-
Lithium (ppm)	-	-
Sulfur as Sulfate (ppm)	-	-

*Concentration of solids is determined by filtration through a pore size of 0.45 micrometer (micron) filter with a line.

Notes:

MWST - makeup water storage tank
MWSG - makeup water to steam generators

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SRP Draft Section 5.4.2.1
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names, abbreviations, and responsibilities for this SRP Section.
2.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names, abbreviations, and responsibilities for this SRP Section. There is currently no secondary review branch designated for this Section.
3.	Editorial	Changed "also" to "These criteria also require" for clarity and completeness.
4.	SRP-UDP format item, Reformat reference citations	Added parenthetical reference identification to the existing citation of the ASME Boiler and Pressure Vessel Code.
5.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names, abbreviations, and responsibilities for this SRP Section.
6.	Editorial	Lettered the section as "A" and added "related to materials selection and design" to provide clarification of the primary PRB's review responsibilities (since the secondary review branch has been eliminated) and to create a parallel subsection organization with specific criteria and Review Procedures.
7.	**Integrated Impact 470**	Added Inconel 690 Ni-Cr-Fe alloy to the list of typical materials used for SG tubes.
8.	Editorial	Deleted a comma and added "and" to clarify the sentence.
9.	Editorial, Current PRB assignments	Introductory text indicating a secondary review by CMEB was deleted.
10.	Editorial	Lettered the section as "B" to provide clarification of the primary PRB's review responsibilities (since the secondary review branch has been eliminated) and to create a parallel subsection organization with specific criteria and Review Procedures.
11.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB names, abbreviations, and responsibilities for this SRP Section.

Item	Source	Description
12.	Editorial	Added "related to secondary water chemistry" and split the second half of the sentence into a separate sentence to provide clarification of the primary PRB's review responsibilities (since the secondary review branch has been eliminated) and to create a parallel subsection organization with specific criteria and Review Procedures.
13.	Current PRB names and abbreviations	Revised to reflect that one PRB (EMCB) is currently responsible for this SRP section.
14.	Editorial	Added a comma and changed "are" to "is" to clarify the sentence.
15.	SRP-UDP format item, Reformat Areas of Review	Added "Review Interfaces" to Areas of Review. Added appropriate interfaces in numbered format. Added a description of how EMCB reviews aspects of the Steam Generator materials under other SRP sections and how other branches support the review.
16.	SRP-UDP Integration of Bolting Issues, Potential Impacts 3004, 23560, and 23561	Added a review interface (EMCB interface 1) reflecting reviews of bolting and threaded fastener programs under new SRP Section 3.13.
17.	Editorial.	To be consistent with the remainder of the section, the acronym SSC for structures, systems, and components was identified.
18.	Editorial	Deleted a comma after "standards" to clarify the sentence.
19.	Editorial.	To be consistent with the remainder of the section the acronym "SSC" was used in place of "structures, systems, and components."
20.	Editorial	Changed "shall" to "will" to clarify the sentence.
21.	Editorial	Deleted two commas to clarify the sentence.
22.	Editorial	Changed item numbers to letters for clarity and consistency with standard outline format.
23.	SRP-UDP format item, reference verification	Added the title for the specific Appendix B criterion used as an Acceptance Criterion.
24.	Editorial	Added the word "shall" to clarify the sentence.
25.	Editorial	Deleted reference to "Primary" review and renamed the section "Materials" review since there are no longer both primary and secondary reviewers.
26.	Editorial	Revised to provide better characterization of the content of RG 1.85 as guidance which identifies acceptable code cases and, where applicable, specifies supplemental information for acceptable use.

Item	Source	Description
27.	SRP-UDP format item, Reference verification	The title of RG 1.85 was revised to reflect the current correct title.
28.	Editorial	Lettered and indented these paragraphs for consistency with the rest of this SRP Section.
29.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB name and responsibility in the designation for the BTP attached to this SRP Section.
30.	**Integrated Impact 468**	Added a specific criterion to verify an adequate corrosion allowance.
31.	Editorial	Deleted reference to "Secondary" review and renamed the section "Chemistry" review since there is no longer a secondary review branch.
32.	Editorial	Changed "purity are monitored" to "chemistry is maintained and monitored" for clarity and to more accurately describe the purpose of the BTP.
33.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB name and responsibility in the designation for the BTP attached to this SRP Section.
34.	Editorial	Lettered and indented these paragraphs for consistency with the rest of this SRP Section.
35.	Editorial	Deleted a comma to clarify the sentence.
36.	SRP-UDP Format Item, Reformat Reference Citations	Added a parenthetical reference citation for ANSI N45.2.1-1973 per SRP-UDP guidance.
37.	SRP-UDP format item, develop Technical Rationale	Technical rationale were developed and added for GDC 1, 14, 15, and 31 and 10 CFR 50 Appendix B per SRP-UDP requirements.
38.	Editorial	Added "reviewer" to the end of the sentence for clarity.
39.	Editorial	Changed the section title from "Primary Reviewer" to "Materials Review" to clarify the primary PRB's responsibilities since there is no longer a secondary review branch for this section.
40.	Editorial	The reference to a previous subsection was corrected from "II.1" to "II.A.1".

Item	Source	Description
41.	**Integrated Impacts 463 and 471**	These integrated impacts deal with various controls and design considerations to prevent IGSCC when using austenitic stainless steel. Steam and feedwater systems do not normally use austenitic stainless steel. However, on a case by case basis, austenitic stainless steel may be used in specific erosion/corrosion control applications. For these unique situations, the reviewer is referred to the austenitic stainless steel controls in SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."
42.	**Integrated Impact 470**	Added a new item to Review Procedures regarding the review of Ni-Cr-Fe alloys used in the SG.
43.	**Integrated Impact 464**	Added a Review Procedure for verifying adequate bolting material.
44.	Editorial	The reference to a previous subsection was corrected from "II.2" to "II.A.2".
45.	**Integrated Impact 468**	A review for adequate corrosion allowance was added to the Review Procedures.
46.	Editorial	Changed the section title from "Secondary Reviewer" to "Chemistry Review" to clarify the primary PRB's responsibilities since there is no longer a secondary review branch for this section.
47.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
48.	Editorial	Revised to eliminate use of a gender-specific pronoun.
49.	Editorial	Added commas before and after "as applicable" to clarify the sentence.
50.	Editorial	An asterisk was added to the parenthetical sentence for consistency with the rest of this subsection.
51.	**Integrated Impacts 463 and 471**	These integrated impacts deal with various controls and design considerations to prevent IGSCC when using austenitic stainless steel. Steam and feedwater systems do not normally use austenitic stainless steel. However, on a case by case basis, austenitic stainless steel may be used in specific erosion/corrosion control applications. For these unique situations, the reviewer is referred to the austenitic stainless steel controls in SRP Section 5.2.3, "Reactor Coolant Pressure Boundary Materials."
52.	**Integrated Impact 468**	Added a reference regarding verifying an adequate corrosion allowance.
53.	10 CFR 52 applicability related change	Standard design certification paragraph was added to the Evaluation Findings section.

Item	Source	Description
54.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
55.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
56.	Editorial, SRP-UDP format item	Revised to reflect a single criterion for consistency with SRP-UDP format for GDC citations.
57.	SRP-UDP Format Item, Verification of References	Four 10 CFR 50 Appendix A GDCs were split into separate references per SRP-UDP format guidance.
58.	Editorial	This and subsequent references were renumbered due to the creation of new reference items.
59.	SRP-UDP Format Item, Verification of References	Reformatted the citation of Appendix B for consistency with SRP-UDP guidance.
60.	SRP-UDP Format Item, Verification of References	Added a reference for Appendix G since it is cited in the text of this Section.
61.	SRP-UDP format item, Reference verification	Changed "of" to "for" to show the correct title of RG 1.37.Additionally, Regulatory Guide 1.37 cites ANSI N45.2.1 with regard to cleaning and cleanliness control. In the System 80+ FSER, the staff indicated that ANSI N45.2.1 was superseded by NQA-2. However, per an 11/94 conversation with Quality Assurance and Maintenance Branch staff, N45.2.1 requirements are being incorporated into NQA-1 and NQA-2. RG 1.28, Revision 3 endorsed NQA-1. NRC has a program to revise the endorsement based on the results of an evaluation of the graded QA program. Also NQA is going through a review of both standards. Per an 11-10-94 telecon with Office of Research staff, two draft regulatory guides were prepared to endorse NQA-1 and NQA-2 through their 1993 addenda. Both regulatory guides were put on hold due to NRC/NEI work on the graded QA program. In the interim, NQA-1 and NQA-2 were consolidated into a new NQA-1.IPD 7.0 form number 4.5.1-3 recommends revising RG 1.37 to cite the appropriate NRC endorsed cleaning/cleanliness standard.No changes will be made to the SRP pending staff resolution of this issue.
62.	**Integrated Impact 464**	Added RG 1.65 to References subsection.
63.	SRP-UDP format item, Reference verification	The title of RG 1.85 was revised to reflect the current correct title.
64.	Editorial, SRP-UDP format item, reference verification	Deleted reference to another SRP section in accordance with SRP-UDP format guidelines.

Item	Source	Description
65.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB name and responsibility in the designation for the BTP attached to this SRP Section.
66.	**Integrated Impact 465**	In the System 80+ FSER, the staff indicated that ANSI N45.2.1 was superseded by NQA-2. However, per an 11/94 conversation with Quality Assurance and Maintenance Branch staff, N45.2.1 requirements are being incorporated into NQA-1 and NQA-2. RG 1.28, Revision 3 endorsed NQA-1. NRC has a program to revise the endorsement based on the results of an evaluation of the graded QA program. Also NQA is going through a review of both standards. Per an 11-10-94 telecon with Office of Research staff, two draft regulatory guides were prepared to endorse NQA-1 and NQA-2 through their 1993 addenda. Both regulatory guides were put on hold due to NRC/NEI work on the graded QA program. In the interim, NQA-1 and NQA-2 were consolidated into a new NQA-1.No changes will be made to the SRP pending staff resolution of this issue.
67.	Current PRB names and abbreviations.	Editorial change made to reflect current PRB name and responsibility in the designation for the BTP attached to this SRP Section. Also added a parenthetical reference to the previous title of this BTP for clarity.
68.	Editorial	Deleted the phrase ", has developed" to clarify the sentence.
69.	Editorial	Capitalized title for consistency with other subsection titles.

Item	Source	Description
70.	Metrication, **Integrated Impact 465**	These units were not converted to Metric equivalents since they are enclosed in a quote from another document. Additionally, in the System 80+ FSER, the staff indicated that ANSI N45.2.1 was superseded by NQA-2. However, per an 11/94 conversation with Quality Assurance and Maintenance Branch staff, N45.2.1 requirements are being incorporated into NQA-1 and NQA-2. RG 1.28, Revision 3 endorsed NQA-1. NRC has a program to revise the endorsement based on the results of an evaluation of the graded QA program. Also NQA is going through a review of both standards. Per an 11-10-94 telecon with Office of Research staff, two draft regulatory guides were prepared to endorse NQA-1 and NQA-2 through their 1993 addenda. Both regulatory guides were put on hold due to NRC/NEI work on the graded QA program. In the interim, NQA-1 and NQA-2 were consolidated into a new NQA-1.IPD 7.0 form number 4.5.1-3 recommends revising RG 1.37 to cite the appropriate NRC endorsed cleaning/cleanliness standard.No changes will be made to the SRP pending staff resolution of this issue.
71.	**Integrated Impact 467**	Added reference to EPRI NP-6239 or other appropriate guidelines for establishing the secondary water chemistry program.
72.	Editorial	The existing specification of temperature range in Fahrenheit was changed to a generic statement independent of temperature scale.
73.	Editorial	Deleted the subparagraph format and subparagraph number for consistency with other subsections.
74.	**Integrated Impact 467**	Added reference to EPRI NP-6239 or other appropriate guidelines for establishing the secondary water chemistry program.
75.	Reference verification, Editorial	The citation of 10 CFR 50.71(a) was deleted since the regulation does not correspond to the stated position. Also changed "shall" to "should" for consistency with the first half of the sentence.
76.	Editorial	Revised to eliminate use of a gender-specific pronoun.
77.	SRP-UDP format item, Reference citations	The citation of a 10 CFR 50 reference was reformatted for consistency with SRP-UDP guidance.
78.	Editorial	Deleted a comma after "frequency" and added a comma after "limits" to clarify the sentence.
79.	Editorial	Added a comma to clarify the sentence.

Item	Source	Description
80.	SRP-UDP format item, NRC metrication policy implementation	The existing criteria of 0.05 to 0.10 µmho/cm for the condensate conductivity increase requiring investigation was converted to 5 to 10 µS/m using the guidance of Federal Standard 376B.
81.	SRP-UDP format item, NRC metrication policy implementation	The existing criteria of 0.10 to 0.20 µmho/cm for the condensate conductivity increase indicating a condenser leak was converted to 10 to 20 µS/m using the guidance of Federal Standard 376B.
82.	SRP-UDP format item, NRC metrication policy implementation	The existing criteria of 20 µmho/cm hrs for the condensate conductivity increase requiring immediate action was converted to 2000 µS/m hrs using the guidance of Federal Standard 376B.
83.	Editorial, Verification of References	Added a Reference subsection for consistency with BTPs in other SRP Sections. Added reference to 10 CFR 50.71 which is cited in the BTP.
84.	**Integrated Impact 467**	Added a citation for EPRI NP-6239 in the References subsection.
85.	**Integrated Impact 467**	Added Table 1 which provides chemistry limits for secondary makeup water.

Integrated Impact No.	Issue	SRP Subsections Affected
463	Consider modifying this section to add RG 1.31 as an appropriate reference for controlling ferrite content in stainless steel weld metal.	-Subsection III, Review Procedures, item A.1 -Subsection IV, Evaluation Findings, item 2
464	Consider revising this section to review the steam generator design for adequate bolting material.	-Subsection III, Review Procedures, item A.1 -Subsection VI, References, item 8
465	Consider revising this section to update cleaning and cleanliness control references.	-No SRP change Note: This Integrated Impact will not be processed pending staff action on NQA-1 and NQA-2.
466	Consider modifying this section to address controls for steam generator materials impurity controls.	-No SRP change
467	Consider modifying this section to address the resolution of USIs A-3, A-4, and A-5 regarding stem generator tube integrity.	Branch Technical Position EMCB 5-3 -Subsection II, items 3.a and 3.c - Subsection III, References, item 2 -Table 1
468	Consider modifying this section to address the incorporation of an appropriate corrosion allowance.	-Subsection II, Acceptance Criteria, item A.2 -Subsection III, Review Procedures, item A.2 -Subsection IV, Evaluation Findings, item 2
469	Consider modifying this section to address controls on grinding more restrictive than RG 1.37.	-No change in this draft revision
470	Consider modifying this section to address the acceptability of Nickel-Chromium-Iron alloys.	-Subsection I, Areas of Review, item A.1 -Subsection III, Review Procedures, item A.1
471	Consider modifying this section to add RG 1.44 as an appropriate reference for controlling the use of sensitized stainless steel.	-Subsection III, Review Procedures, item A.1 -Subsection IV, Evaluation Findings, item 2
472	This Integrated Impact identifies a future work item to revise RG 1.37 to endorse the current version of ASTM A262.	-No SRP change This item is being tracked on IPD-7.0 form 4.5.1-4.